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# A MORE COMFORTABLE WAY OF USING COLD IN FEVERS.

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# A MORE COMFORTABLE WAY OF USING COLD IN FEVERS.

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It is universally agreed that cold is our best and safest antipyretic, but the method of applying it by a cold bath taxes the strength of the patient, and the lack of conveniences in ordinary practice for such baths, and of persons who know how they should be given, as well as the objections made by the patient and friends, are obstacles to its use.

My purpose is to show how the temperature can be reduced by the use of cold by a more comfortable method than the cold bath. The successful use of my method of cooling requires that a few conditions be appreciated and carefully fulfilled; its essential points are that the body be covered by a layer of thin gauze on which warm water is sprinkled; the temperature of the body is reduced by the evaporation of this water, which evaporation and cooling are promoted by a current of air.

The rapidity of the cooling depends to a considerable extent upon the dryness of the air and the volume of it at our disposal. In Boston, for example, during the season when the houses are heated the percentage of moisture indoors is low, and during the summer months, though the percentage of moisture may be two or three times as much as during the winter months, by means of open windows the volume of air at our disposal is large. Either a smaller volume of dry air or a larger quantity of moister air will serve the purpose, as the quantity of water the air has to take up is not large, and is required only at intervals. The doors of the room should be open, and in warm weather the windows also. Exceedingly favorable conditions would be found in dry, warm climates.

To gain some idea of the efficiency of this method of cooling and the best way to employ it, I took a large bottle, holding rather more than a gallon of water, the temperature of which was 104° F. The bottle was wrapped with surgical gauze (having about sixteen threads to the inch), which was sprinkled with water at short intervals, and fanned continuously by an electric fan. In this way the reduction in the temperature of the water in the bottle during half an hour could be ascertained under varying conditions. From such experiments, which of course do not represent all of the conditions present in the body, it was found that the water in the bottle could be cooled about 28° F. below its initial temperature of 104° F. in half an hour, the temperature of the air in the room being 70° F. This method is similar to the one which has been used for many centuries in hot, dry climates to cool drinking-water.

I made tests in which the number of thicknesses of gauze covering the bottle was varied, and found that one or two thicknesses of gauze gave better results than several; four or six, for instance. It is of importance to have the covering for the surface to be cooled a suitable one; something which will hold a thin layer of water on the skin without protecting the skin will accomplish the end in view. The gauze increases the surface from which evaporation takes place.

I compared the amount of the cooling of the water in the gauze-covered bottle which took place when an electric fan was used to create a draft with that obtained by hand-fanning, using two palm-leaf fans tied together to stiffen each other. I found that, under the same conditions, the temperature of the water in the bottle was lowered about four-fifths as much in half an hour by the hand-fanning as by the electric fan. In private practice, therefore, it would be quite feasible to employ this method, using a hand-fan; but in a hospital ward an electric fan would be better, as to fan several patients a number of times during the day would tire the arm of an attendant. Further, I found that the reduction in temperature was about twice as great if the wet gauze were fanned as when evaporation took place unaided by this process.

I also tried moistening the gauze with alcohol (95 per cent.) instead of water, and found that the temperature of the water in the bottle was *not* much more reduced in half an hour than it had been when water was used on the gauze; the difference between the two was

about 10 per cent. This did not seem to me sufficient to offset te inconvenience of alcohol. About four or five times as much alcohol as water would have to be evaporated to obtain the same amount of cooling, the latent heat of water being much greater than that of alcohol. Alcohol is inflammable and expensive, and leaves a stuffy odor and might irritate the skin.

The use of *cool* or of *ice-water* to moisten the gauze suggested itself. I therefore placed two of the gauze-covered bottles in the same current of air, one of them being kept wet with water at 100° F., the other with ice-water (32° F.); at the end of half an hour the difference in temperature of the water in the two bottles was only one degree, a difference of about 5 per cent. This experiment was repeated, using cold water on the bottle which had previously had warm water, with the same result. This slight increase in cooling by sprinkling the patient with cold instead of warm water does not offset the discomfort of the shock, which even cool water gives and of which patients complain. By using warm water to moisten the gauze and continuing the current of air one or two minutes longer, we can readily obtain fully as much cooling as when cold water is used for the slightly shorter period. If for any reason this shock to the nervous system is desired, cool water may be used.

In cases of fever, by first cooling the outer layer of the body for a few minutes by the evaporation of water warmer than the patient (about 115° F.), and then momentarily warming the surface thus cooled by sprinkling again with the warm water, we may draw the blood to the surface and send it back cooler to the interior of the body, and thus by the alternate dilatation and contraction of the superficial bloodvessels, we may accomplish more reduction in temperature than by a continuous cooling of the skin. That is, physiologically, there are advantages in moistening the gauze on a patient from time to time with water warmer than the patient, rather than with cool water, which would not be apparent in a simple *physical* experiment.

To cool a fever patient by applying warm water rather than cold water seems paradoxical; but it is, I think, the better way, and is more acceptable to the patient.

Brandy or whiskey administered before giving the bath would promote the dilatation of the superficial bloodvessels.

For the bath which I propose, the patient has a rubber cloth or

woollen blanket put under him; strips of coarse gauze such as is used for surgical dressings are then placed on him, of a size suitable to go fully three-fourths around each leg and arm, and the trunk; when moistened they should cling closely to the skin, and there should be only one thickness of gauze. This is sprinkled with water,[1] and the patient fanned. The fanning, with sufficient sprinkling from time to time to keep the gauze wet, is continued as long as may be suitable for that individual. By repeating such baths frequently, or continuing them for twenty minutes or half an hour, a considerable amount of heat can be carried off from a patient with pyrexia. They are not so mild in their effects as to permit one to disregard the possibility of partial collapse, in very weak patients, if pushed too far.

If one pint of water is evaporated in one-quarter of an hour, the patient's temperature will fall about so many degrees; but if there happens to be a high percentage of moisture in the air of the room, a longer time is required to evaporate that amount of water, say half an hour, and there would not be quite so much lowering of the patient's temperature as when the evaporation occurs in the shorter time.

In order to have some suggestion of what such a bath may accomplish in fifteen minutes, I made a comparison between it and sponge baths, given in the following way: The patient having been suitably arranged on a rubber sheet, a large sponge was dipped into a pail of water at 70° F., the excess of water squeezed out, and the patient sponged; the sponge was then squeezed out into an empty pail, dipped in a basin containing ice-water to cool it, and squeezed out, then again dipped into water at 70° F. and applied to the patient. This makes a very good sponge-bath. Both kinds of baths were kept up for fifteen minutes.

For this comparative test I choose one ward, during a service at the Boston City Hospital, and had one-half the typhoid patients who were admitted to it during five weeks in the summer of 1893 sponged, as detailed above, and the other half treated by covering three-quarters of the body with a layer of gauze moistened at intervals by sprinkling

[1] I use a No. 1 (not No. 4) Davidson's syringe, on to which is screwed a small hard-rubber tip about an inch long and one-half inch in diameter, perforated at the end with a dozen holes each about one-sixty-fourth of an inch in diameter. These tips are made by the Davidson Rubber Company, Boston. The gauze should be kept wet, and if the sprinkling is properly done very little water reaches the blanket on which the patient

with water, and fanned as already described. The patients were chosen alternately. There were in all eight patients, four treated in each manner, each patient receiving a number of baths. I did not pursue the comparison on a large number of patients, as they had to be fanned by hand. If electric fans are used, it would be less irksome for the attendants in a ward to give these baths than to give sponge-baths. The directions were to give a bath whenever the axillary temperature of the patients was 103° or over; 102° might be a better temperature. The rectal temperature was taken one-half hour after the bath, using a clinical thermometer without a self-registering index. On the average the temperature was reduced by sponging rather less than ½°, and by baths with fanning rather more than 1° F., and the reduction in temperature continued for a longer period; but this comparison is based on too few patients to be exact. Now and then the temperature was reduced 2°, 3°, and in some instances 3½° by one of my baths.

The duration of these baths was fifteen minutes; but it is better to be guided by the quantity of water evaporated rather than by the time, as on dry days a shorter time is required to evaporate the same amount of water than on moist days.

A. B., a strong man who had typhoid fever, with a temperature frequently above 103° during three weeks, was given the baths, with hand-fanning, two or three times a day, or whenever the temperature reached 103° F. Each bath was continued about half an hour, and about one quart of water was evaporated at each bath. The average reduction in temperature of ten baths was 2.2° F. Twice during the period when these ten baths were given a cold bath (65° F.) was given for fifteen minutes to the same patient in place of the other bath; in one of the cold baths the temperature was reduced 3.1° F., in the second 2.6° F., an average of 2.8° F.

The average reduction in temperature of twenty-two baths by hand-fanning given to patients with typhoid fever during July was 2.6° F.; the time required for each bath varied from fifteen minutes to half an hour; and the amount of water evaporated was about one quart—at times much less, sometimes more. The temperatures were taken in the mouth, and the lowest temperature was sometimes not reached for one or even two hours after the bath; once the temperature fell 4° F., and once 5° F. The amount of moisture in the air while these baths were given was probably not far from 70 per cent.

It is well to begin with a bath during which a pint of water is evaporated, and in subsequent baths be guided, as to the amount of water to be used, by the effect of the previous one. In the later stages of typhoid fever one should remember that the same patient is more susceptible to the action of cold than he was in the earlier stage.

The principle underlying this method is made more evident when we consider that the cooling which takes place when 5 c.cm. (one teaspoonful) of water are evaporated at 104° F. represents roughly the reduction in temperature of a quart of water cooled from 104° to 99° F., or cooling more than a gallon of water 1° F. The heat taken to evaporate a pint of water is sufficient to cool 289 pounds of water about 4° F.

To ascertain whether the heat which evaporated the water was withdrawn from the air of the room, which was usually about 70° F., or from the body of warm water in the bottle, the amount of water which was evaporated in half an hour from the surface of a large bottle covered with gauze when fanned was measured, and it was found by calculation that the amount of heat lost by the water in the bottle was due chiefly to the evaporation of the water applied to the bottle. For example, it was demonstrated, in one experiment, that 4000 c.cm. of water (the amount contained in the bottle) at 104° F. were cooled 22.5° F. in half an hour, and that 108 c.cm. of water were evaporated. Standing in the room, such a bottle of water would have lost 4½° F. To lower the temperature of 4000 c.cm. of water 18° F. requires the evaporation of 70 c.cm. of water; as not more than 108 c.cm. of water were evaporated in all, it is evident that most of the heat needed to evaporate the 108 c.cm. of water came from the warm water in the bottle, and not from the air.

The amount of heat withdrawn from the patient may be varied by increasing the duration or frequency of the baths. I have used this method in typhoid fever and pneumonia, the patients had less delirium and slept better, and it seems to me to combine comfort, convenience, and efficiency to a greater extent than most other means of reducing temperature in cases of fever. I have had more than one hundred of these baths given with excellent results, and the method seems to me worthy of further and careful study.